Structure, molecular mobility and properties of polypropylene block copolymers.

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Isotactic polypropylene (iPP) shows properties similar to those of high density polyethylene (HDPE). However, iPP has poor impact strength and is brittleness at low-temperatures, which limits its applications.[1] Increase in the low-temperature impact strength of polypropylene (PP), is a key to further broadening its and end-use properties in areas like infrastructure, automotive and packaging. Therefore, composite materials based on modified PP systems have been introduced into the market to meet application demands since customers want grades where typical performances of homo-, random-, and heterophasic-PP (called also PP block copolymer) are found in one and the same product. The development of new systems, which show an improved balance between properties, represent therefore one of the major challenges to PP industry.

PP block copolymers are an intimate blend of homopolymer and an elastomeric material. This elastomer is added to the homopolymer and then blended physically, or are produced through polymerization in situ to get a chemical blend. In the past decades, PP has been improved by physical blending with a little amount of rubbers like ethylene-propylene rubber (EPR).[2] Notwithstanding this, the modified mechanical properties of these blending systems have not been able to fully satisfy industrial demands due to the incompatibility between phases. In order to solve the compatibility in physical blends, several studies have described the production of PP alloys in a chemical reactor due to the great scientific and industrial interests.[3] In this case, PP is first synthesized in a liquid-phase loop reactors and the produced flakes flow to a second gas-phase reactor where ethylene and propylene are fed in a to produce EPR which is dispersed in the PP matrix.[4]

In this work, we try to understand the microstructure of PP block copolymer influence on phase-morphology and mechanical properties of this kind of polymers. This can be done by preparing two series of physical blends, one of them biphasic based on iPP and EPR; and the other triphasic composed by iPP, EPR and HDPE. The goal is to simulate the composition of commercial PP block copolymers, which are synthesized in a chemical reactor. Phase structure of physical blends has been analyzed by multidimensional solid state NMR spectroscopy in order to provide additional information non-accessible by other techniques. Thus, and by combination of ^{1}H wideline NMR, cross polarization (CP) and ^{13}C MAS spectroscopy in a 2D experiment is possible to obtain information about the mobility of the different structural units, being potentially valuable for many industrial applications. At last, results will be compared with commercial PP block copolymers, which have been analyzed in our group.[5]

References:

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